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Neandertals paleoenvironment in Western Provence: The contribution of Les Auzières 2 (Méthamis, Vaucluse, France)

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Abstract

The site of Les Auzières 2 (Méthamis, Vaucluse) was excavated from 2001 to 2005. It yielded an original and diverse fauna, unique in southeastern France (Provence). The spectrum of large mammals comprises 14 species including hyena, horse, ibex, woolly rhinoceros, giant deer and mammoth. Lithic artifacts are rare but testify to the presence of a Mousterian industry. All of these remains derive from layers that have been dated to 60 ± 10 ka by ESR/U-series method. Les Auzières 2 is of special importance for examining the issue of human/carnivore interaction in the Pleistocene since it has yielded a large assemblage of carnivore remains, and probably represents a hyena den. The diverse fauna offers a more comprehensive picture of Upper Pleistocene biodiversity in southeastern France than that usually provided by sites with a stronger anthropogenic signal. ***To cite this article: F. Marchal et al., C. R. Palevol 8 (2009).***

Résumé

L'environnement des Néandertaliens en Provence occidentale : l'apport du site des Auzières 2 (Méthamis, Vaucluse, France). Fouillé de 2001 à 2005, le site des Auzières 2 (Méthamis, Vaucluse) a livré une faune unique et originale pour le Sud-Est de la France (Provence). Celle-ci est composée de 14 espèces de grands mammifères, dont l'hyène des cavernes, le cheval, le rhinocéros laineux, le mégacéros ou encore le mammouth. L'ensemble de ces vestiges provient de niveaux datés de 60 ± 10 ka par les méthodes combinées de l'ESR et des séries de l'uranium. La présence de rares artéfacts lithiques de manufacture moustérienne atteste la présence de groupes humains non loin du site. L'accès à une faune aussi variée permet d'offrir une meilleure image de la biodiversité au Pléistocène supérieur en Provence que ce que ne permettent les sites plus anthropisés. Les Auzières 2 est aussi une

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importante contribution à la problématique des interactions hommes/carnivores au Pléistocène. ***Pour citer cet article : F. Marchal et al., C. R. Palevol 8 (2009).***

Keywords: Hyena den; Upper Pleistocene; Middle Paleolithic; Mousterian; Palaeoecology; Provence; France

Mots clés : Repaire d'hyènes ; Pléistocène supérieur ; Paléolithique moyen ; Moustérien ; Paléoécologie ; Provence ; France

1. Introduction

During these last decades, a strict methodology for the study of taphonomic processes has been developed, allowing a better understanding of the origins of bone accumulations and site formation processes *in extenso*. One of the most important issues in this respect is the interaction between humans and carnivores and the extent of their respective involvement in the formation of bone assemblages. In this debate, a wealth of data is available for Upper Pleistocene sites in the South-West of France [4,28,41,43]. The bearing of sites from southeastern France on this debate has been minor, not because they are less numerous than their southwestern homologues, but primarily since most of them are of small size and/or have yielded a small number of remains. Hence, only several Pleistocene sites are known in western border of Provence, and these have yielded more or less important Middle/Upper Pleistocene assemblages, like, notably La Combette [39,40], Bau de l'Aubesier [15,23,24], Baume des Peyrards [26,36], Bérigoule [7,38], Abri des Puces, Vallescure, grotte de la Masque [13,35], l'Adaouste [13], the Cèdres Cave [12] or in the eastern part of the Provence, for example, Le Lazaret [42]. Augmenting the number of well-known Pleistocene localities is a key step to improving our knowledge of the Pleistocene in southeastern France, addressing among other issues, paleoenvironment, interactions between humans and carnivores, and the nature of early human settlements, and ultimately arriving at regional comparisons. It is in this context that we undertook the excavation of the cave of Les Auzières 2.

The Auzières 2 site was first mentioned following a test pit excavated in 1980 by Livache and Paccard [33]. This work provided preliminary stratigraphy and yielded abundant and well preserved faunal remains in the Lowest Pleistocene levels. An initial analysis of this material enabled Crégut-Bonnoure et al. [10] to provide a biochronological assessment of the Early Würm. In 1998, we made a second test pit which confirmed the faunal richness and precised the stratigraphy [30]. This led us to undertake excavations. We present here pluridisciplinary preliminary analyses resulting from six months of field work.

2. The site

The Auzières 2 is located near the village of Méthamis (Vaucluse), at the outlet of the upper Nesque Gorges (Fig. 1). It belongs to a small set of three cavities (called Les Auzières 1, 2 and 3), situated about 300 m a.s.l. and which have unobstructed views to the east. The Nesque Gorges are the limit between the southern slopes of Mount Ventoux (1909 m a.s.l.) and the western end of the Vaucluse Mounts (up to 1256 m a.s.l.). West of this lies the Carpentras plain, a basin filled by mostly marly Oligo-Miocene sediments. From a hydrological point of view, the eastern mountainous area is karstic and very dry whereas the western plains are drained by several small rivers, including the Nesque after its resurgence. The Auzières 2 site therefore holds a special position lying at the boundary between two large geological, geomorphological, geographical and hydrographical complexes. It is very likely that this position will be of some importance in the study of the site, at least as far the faunal remains are concerned.

The Auzières 2 cavity was the only one of the three small, adjoining caves nearly filled by sediments, almost up to the roof, which was preserved at the back of the cave. The roof in the front of the cave was missing, possibly collapsed, but the sediments in the area lay in an open-air talus covered by the Mediterranean forest and a thick soil layer. Since our excavation never reached bedrock, we do not know the exact thickness of the sedimentary sequence. It is at least 4 m thick, since we reached this level from our reference plane that fitted, almost perfectly, the original ground level before the excavation.

3. The Pleistocene deposits

The Pleistocene deposits themselves are at least three meters thick, since the present-day soil is about 1 m thick. The current stratigraphy comprises seven main

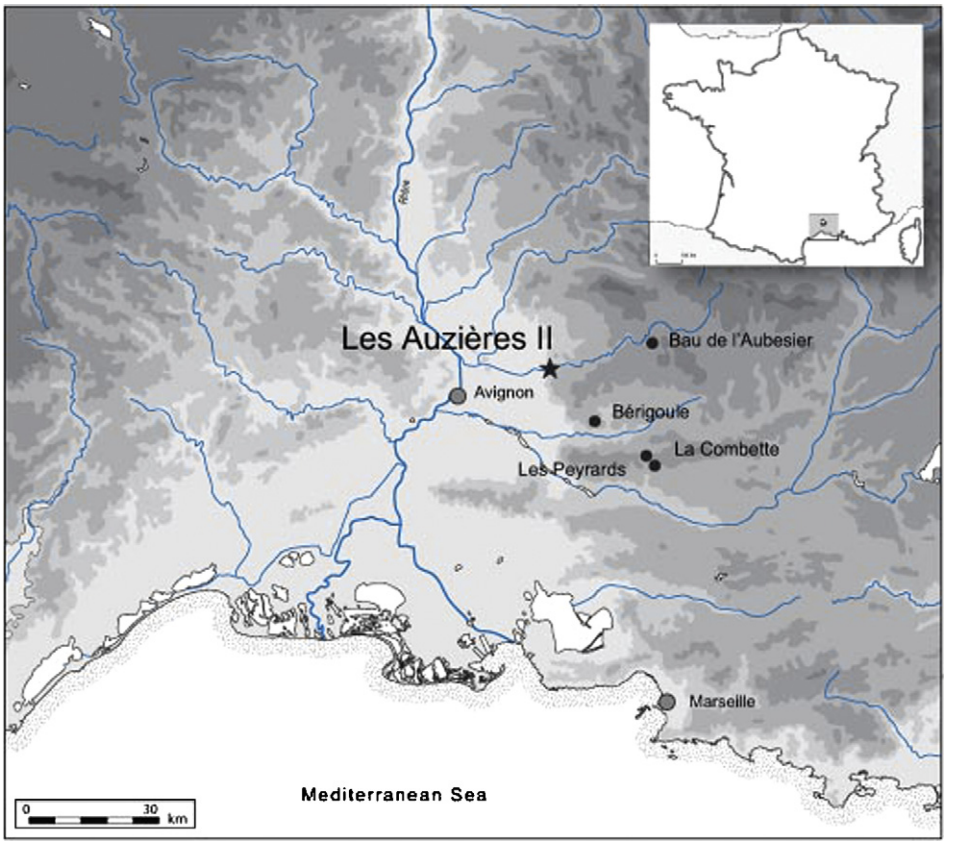

Fig. 1. Location of the Auzières 2 and some archaeological sites in western Provence (France).
Fig. 1. Localisation du site des Auzières 2 et de quelques sites archéologiques en Provence occidentale (France).

layers called Ca for the present-day soil down to Cf for the deepest one. This latter layer was divided into three sub-layers Cf1, Cf2 and Cf3. A seventh layer, C1 was identified at the top of the filling and was present only under the cave vault (Fig. 2).

The formation of the different layers could result from two distinctive depositional processes: frost shattering and fluvial sedimentation. The presence of limestone clasts in the layers probably results from frost shattering of the cave walls during glacial time. For instance, the Bau de l'Aubesier rock-shelter located at the inlet of the Nesque Gorges, exhibits evidence for a strong episode of destruction during the last glacial period [5]. It is likely that the Auzières 2 cave experienced the same event since it is hollowed in the same Urgonian limestone and very close to the Aubesier rock-shelter. Information about the past configuration of the Auzières 2 cave is found in the geological record. The sediments slope clearly towards the northeast of the cavity (in our reference system). The successive layers are separated by episodes of erosion and the erosion is always more intense in the north-eastern part of the cavity. These clues, together with the discovery of a NE-SW oriented Urgonian wall covered by speleothems, offer strong evidence for a Pleistocene opening of the cavity toward the south-west (in our reference frame but a geographically north-east opening).

The stratigraphy, as well as studies of grain size and micromorphology of the fine sediments, shows their fluvial origin (laminated layers, good sorting and porosity). During flood events, the Nesque River could have deposited the sediments inside the cave. The large percentage of clay particles in the layers Cf3, Cf2, and Cf1 testifies to a low-energy (deposition) environment. In contrast, the laminations of the sandy layers Ce and Cb indicate a high-energy (deposition) environment. The granulometry of the Cc and Cd layers attests to an intermediate energy depositional environment. We interpret this heterogeneity in the alluvial sediment granulometry (from clay to sand) as the result of variability in the time taken for deposition of the hydrodynamic (transport and deposition) conditions. In addition, the presence of iron oxides, which could be derived from Tertiary formations, is a further clue to support the hypothesis that this sequence is mainly fluvial in origin.

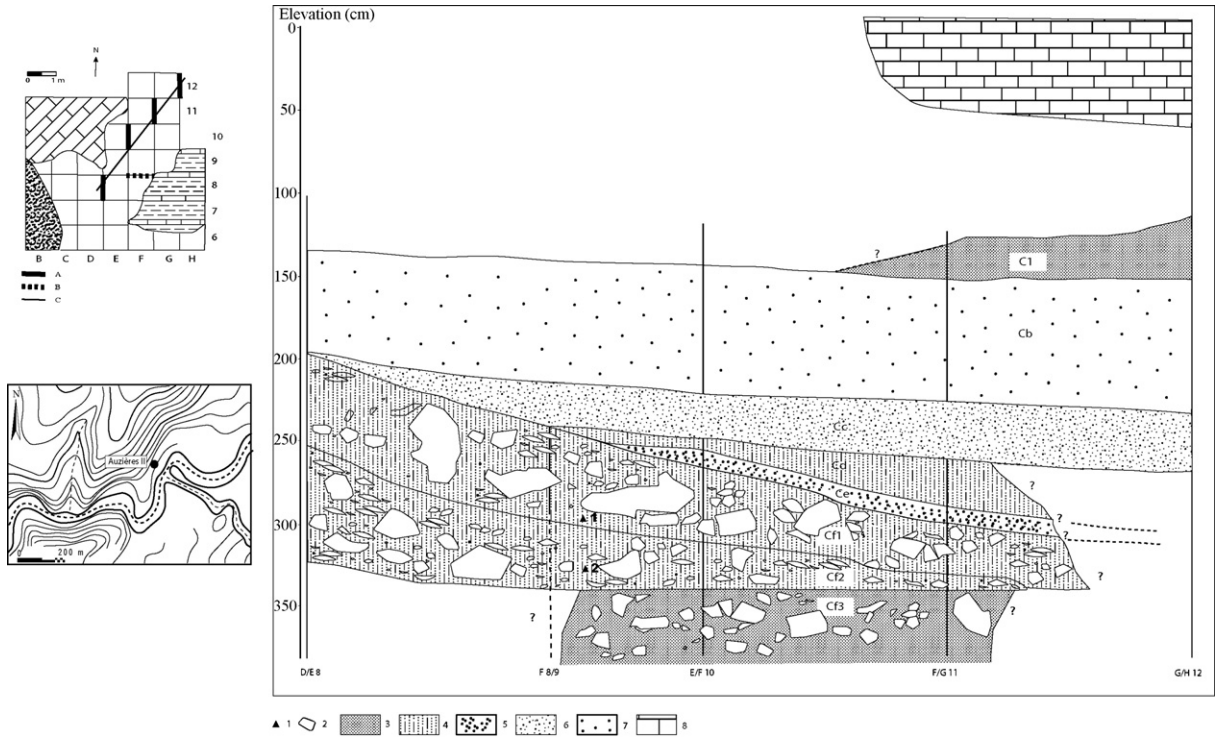

Fig. 2. Synthetic stratigraphic section through the long axis of the cave. **A**. Used real section. **B**. Section thrown in the axis of the cave. **C**. Synthetic section reconstituted in the axis of the cave. **1**. Dosimeter. **2**. Limestone boulder or speleothem. **3**. Clayey silt. **4**. Sandy and clayey silt; **5**. Sand; **6**. Sandy silt. **7**. Silty sand.

Fig. 2. Coupe stratigraphique synthétique suivant l'axe principal de la grotte. **A.** Coupes réelles utilisées. **B**. Coupe projetée dans l'axe de la grotte. **C**. Coupe synthétique reconstituée dans l'axe de la grotte.**1**. Dosimètre. **2**. Bloc de calcaire ou de spéléothème. **3**. Limon argileux. **4**. Limon sablo-argileux. **5**. Sable. **6**. Limon sableux. **7**. Sable limoneux.

4. Th/U dating

In order to precise the chronological timing of the infilling, several dating methods have been used. Several speleothem fragments recovered in secondary depositional location in layers Cf and C1 have been dated by the ^{230}Th-^{234}U-^{238}U systematics U-series [37], using both alpha-spectrometry (MNHN, Paris) and TIMS (GEOTOP, Montreal) analytical methods. Even if only indirect dates can be obtained by this latter approach using displaced speleothems, several stages of calcite formation have been recognized, during and before marine isotopic stage (MIS) 7, around 250 000 years ago. It is a clear indication that the cavity already existed at least during the Middle Pleistocene. This age also provides a maximum age for the palaeontological and archaeological remains.

Additionally, three horse teeth recovered from layers Cf1 and Cf2 were dated by ESR/U-series method [18,19] according to the protocol described by Bahain et al. [2] (Table 1). The obtained ages, respectively 60 ± 8, 69 ± 7 and 50 ± 7 ka, clearly place the analyzed palaeontological remains in the Upper Pleistocene. A weighted mean age of 60 ± 10 ka permits us to propose that the archaeological level dates to the marine isotopic stage 4, even if the 5-4 and 4-3 transitions cannot be completely eliminated.

5. The faunal assemblage

5.1. Large mammals

All the specimens come from layer Cf. Despite the small number of identified remains (NISP = 173) and an apparent poverty in richness (Richness index = 3.861), the taxonomic composition of the Auzières 2 assemblage is very diverse (Shannon index = 3.479, $E = 0.914$) and does not show a predominant species (Simpson index = 0.076) [27]. The most common mammal is the horse (*Equus caballus* cf *germanicus*), followed by the spotted hyena (*Crocuta spelaea*) and ibex (*Capra sp.*). Remains of the other species are scarce, but the presence of the wooly rhinoceros (*Coelodonta antiquitatis*), giant deer (*Megaceros giganteus*) and mammoth

Table 1
Palaeodoses, Uranium uptake (p) parameters, contributions of the different rays to the annual dose rate and ESR/U-Th series ages obtained on the analyzed samples from the Pleistocene site of Les Auzières 2.
Tableau 1
Paléodoses, paramètres (p) d'incorporation de l'uranium, contributions des différents rayonnements au débit de dose annuelle et âges ESR/U-Th obtenus sur les échantillons analysés provenant du site pléistocène des Auzières 2.

Sample	Tissue	Palaeodose (Gy)	p parameter	D_α [*] (μGy/year)	D_β (μGy/year)	$D_{\gamma+cosm}$ [**] (μGy/year)	ESR/U-series age (ka)
MLA	Cement		−1.000 [***]				
2003-01	Dentine	38.6 ± 2.4	−0.08 ± 0.33	82 ± 31	201 ± 55	361 ± 20	60 ± 8
(F9-271-4)	Enamel		−1.000 [***]				
MLA	Cement		−1.000 [***]				
2003-02	Dentine	47.7 ± 2.2	0.00 ± 0.2	97 ± 30	234 ± 50	361 ± 20	69 ± 7
(F9-281-5)	Enamel		−1.000 [***]				
MLA	Cement		−1.000 [***]				
2003-03	Dentine	38.6 ± 2.4	−1.000 [***]	153 ± 52	267 ± 60	361 ± 20	50 ± 7
(F9-284-6)	Enamel		−0.89 ± 0.14				

[*] A k-factor (alpha efficiency) of 0.13 ± 0.02 was used following Grün and Schwarcz [18].
[**] The gamma dose rate was measured in situ with TL $CaSO_4$ dosimeters. The cosmic dose was calculated from the data of Prescott and Hutton [34].
[***] p-values blocked at $p = -1$ (EU model).

Table 2
Distribution of large mammals in Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI) for Les Auzières 2. In bracket: number of remains identified in the first test-pit in 1983.
Tableau 2
Distribution des grands mammifères en Nombre de spécimens identifiés (NISP) et Nombre minimum d'individus (MNI) pour les Auzières 2. Entre parenthèses: nombre de restes déterminés à partir du premier sondage en 1983.

		NISP	MNI
Carnivora			
Spotted Hyena	*Crocuta spelaea*	37 (9)	5
Red Fox/Arctic Fox*	*Vulpes vulpes/Alopex lagopus*	19 (1)	3
Lynx	*Lynx spelaea*	5 (2)	1
Bear	*Ursus* sp.	2	1
Wild Cat	*Felis silvestris*	1	1
	Total	64	11
Herbivora			
Horse	*Equus caballus* cf *germanicus*	59 (9)	5
Ibex	*Capra* sp.	20 (2)	4
Woolly rhinoceros	*Coelodonta antiquitatis*	12 (6)	2
Red Deer	*Cervus elaphus*	6 (2)	2
Chamois	*Rupicapra rupicapra*	3 (2)	1
Giant deer	*Megaceros giganteus*	3	1
Mammoth	*Mammuthus primigenius*	3	1
Aurochs	*Bos primigenius*	2	1
Small Horse	*Equus hydruntinus*	1	1
	Total	109	18
Total		173	29

* If the common fox (Vulpes vulpes) is indubitably present in the bone assemblage, the presence of the arctic fox (Alopex lagopus) is suspected [10] but unconfirmed.
Si le renard roux (Vulpes vulpes) est indubitablement présent au sein de l'assemblage osseux, la présence du renard arctique (Alopex lagopus) est suspectée [10] mais non confirmée.

(*Mammuthus primigenius*) should be noted because this is exceptional compared to other Pleistocene sites in the region (Table 2). As a consequence, this faunal association is unique and has never been reported in one site during the Pleistocene in southeastern France.

The wooly rhinoceros, the mammoth are the only representative species of fresh fauna. The woolly rhinoceros and the woolly mammoth correspond to a much more open environment and are particularly associated with cold meadows which predominated during episodes of climatic fluctuations. In this list of cold fauna, only the reindeer (*Rangifer tarandus*) is missing, but this species is very rare or absent in assemblages from Provence. Indeed, although the reindeer were an abundant species described in the Pleistocene of southwestern of France [14], this species has only been described from a few sites in southeastern of France, especially in Vaucluse/Bouches-du-Rhône e.g. in Aven des Planes with an almost complete skeleton [1], in Adaouste cave, where one incomplete radius and one phalanx were identified [13], in Cedres cave where a single distal radius was reported [12], one bone from Bau de l'Aubesier cave level H [15] or still in Chinchon 1 with 15 remains essentially antler fragments and phalanx [11]. The scarcity of the reindeer in Provence is certainly a consequence of the geomorphology of the southeastern of France, where the zones of plains are rare and dry climatic conditions prevailed [1].

The horse, which characterizes a cool, steppe environment, has the same evolutionary stage than the horse found in the Baume des Peyrards (*Equus caballus* cf *germanicus*) [36], which is contemporaneous to isotopic

stages 3 to 5 (Early Würm and Würm II). Consequently, the horse morphology allows us to place Auzières 2, later than the older form of Bau de l'Aubesier (*Equus mosbachensis* and *Equus* cf *taubachensis*) [15] and at the same chronological level as la Baume des Peyrards or la Combette site (*Equus caballus*) [39,43].

The presence of cliff dwelling species like ibex and chamois remind us of the presence of numerous rocky escarpments in the vicinity of the Nesque valley. The ibex was abundant in assemblages from Baume des Peyrards [36] and La Combette [40], whereas the Bau de l'Aubesier yielded another cliff-dwelling bovid, *Hemitragus cedrensis* in the lower levels and *Capra caucasica* in the upper levels [15]. In western Europe, the migration of the Alpine ibex and the chamois are synchronic and are the result of climatic deterioration observed in isotopic stage 6 [9].

5.2. Birds

The presence of the Alpine Chough (*Pyrrhocorax graculus)* is attested to by one distal extremity of a right metacarpal [10]. This sedentary species is widely represented in Pleistocene deposits in Europe [22,32] and represents a typical paleomountain species inhabiting the Mediterranean mountain zone over 1000 m a.s.l. These birds live in colonies and build their nests on the ledges of vertical walls, rather in the calcareous massifs [13].

5.3. Micromammals

The sieving and the sorting of sediments resulting from levels Cf1, Cf2 and Cf3 facilitated the recovery of remains of micromammals. Like the large vertebrates, these assemblages are not very large or rich, but they are relatively diverse (Table 3).

The presence of thermophile species like the Horseshoe bat (*Rhinolophus* cf *euryale*) and the Mediterranean Pine Vole (*Microtus duodecimcostatus*) suggest a temperate climate. These two species are frequently encountered today in the Mediterranean area. However, the Horseshoe bat is associated in Auzières 2 with the common and pygmy shrew (*Sorex minutus)*, both species occupy the whole of middle Europe from the Mediterranean Sea to the Arctic ocean, and as such restrict the amplitude of the warm climatic conditions that prevailed. The presence of *Eliomys quercinus, Apodemus sylvaticus* and *Microtus agrestis* in levels Cf1, Cf2 and Cf3 of the site suggest a wooded environment in its vicinity.

This micromammalian assemblage is composed of species which are common today. Thus, layers Cf1 to Cf3 of the Auzières 2 could date to a temperate phase of the Upper Pleistocene, but no greater precision is possible because of the paucity of the faunal material. On the other hand, no evidence for climatic variation has been found in the deposits.

Table 3
Micromammal distribution in Minimum Numbers of Individuals (MNI's) for the three Cf layers at Auzières 2.
Tableau 3
Distribution des micromammifères, en Nombre Minimum d'Individus (MNI) pour les trois niveaux Cf des Auzières 2.

	Levels		
	Cf1	Cf2	Cf3
Insectivora			
Erinaceus cf. *europaeus* Linné, 1758		1	1
Talpa cf. *europea* Linné, 1758			1
Sorex minutus Linné, 1766			1
Sorex araneus Linné, 1758			1
Chiroptera			
Rhinolophus cf. *euryale* Blasius, 1853			1
Rodentia			
Eliomys quercinus Linné, 1766	1		1
Apodemus sylvaticus Linné, 1758		1	5
Microtus agrestis Linné, 1761	1		3
Microtus cf. *arvalis* Pallas, 1758			1
cf. *Chionomys nivalis* Martins, 1842	1	1	
Microtus (Terricola) cf. *duodecimcostatus* de Sélys-Longchamps, 1839		4	2
Lagomorpha			
Oryctolagus cuniculus Linné, 1758	1	2	1

6. Lithic industry

Flint artifacts are very sparse in the lower levels where only twenty-four pieces were found. Even if limited, this lithic assemblage contains interesting data (Fig. 3). Three flakes of *débitage* and one pseudo-Levallois point are associated with Levallois technology. Among the flakes, Levallois and *débitage* flakes prevail. Four pieces could be related to blade production. Only two pieces have been retouched: a Mousterian point made on a Levallois flake, bearing regular and oblique retouch, and a partial scraper. Direct percussion with a hard hammer was used for the production of almost all the flakes. The use of soft hammer is possible only for two flakes. Cores, fully or partially cortical flakes and flakes of less than 25 mm are uncommon. This seems to exclude the *in situ* production of these flint artifacts. Even if humans were not the main agents of bone accumulation in the site, their presence is attested to by more than twenty Mousterian artifacts. Their scarcity would suggest a very temporary occupation, maybe over the

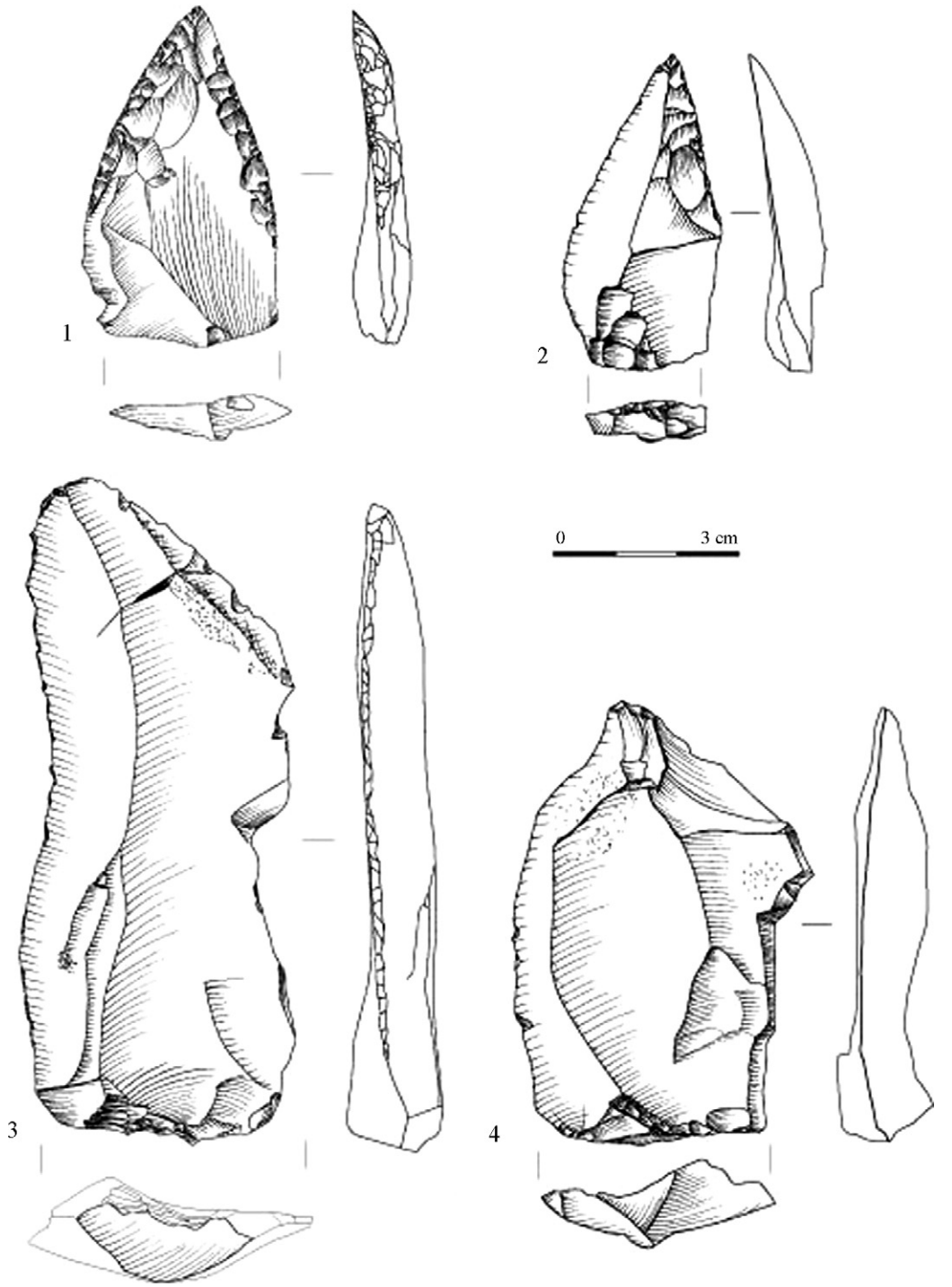

Fig. 3. Lithic tools from the Auzières 2. **1**. Mousterian point (E6 Cf). **2**. Partial sidescraper (D8 Cf2). **3**. Levallois flake (F10 cf3 50). **4**. *Débitage* flake (E10 Cf3 105).

Fig. 3. Industrie lithique des Auzières 2. **1**. Pointe moustérienne (E6 Cf). **2**. Racloir latéral partiel (D8 Cf2). **3**. Éclat Levallois (F10 Cf3 50). **4**. Éclat de plein débitage (E10 Cf3 105).

rock shelter or at the level of the past entrance of the cave.

6.1. Preliminary taphonomic considerations

Without entering into the details of the taphonomic study that will be developed in a forthcoming work, several points can be noted in the Auzières 2 assemblage. Firstly, the faunal assemblage shows a high proportion of carnivores to ungulates: hyenas comprise 21.4% and other carnivores (lynx, fox, wild cat and bear), 15.6% of the total ungulate + carnivore NISP. If MNI's are considered, the carnivores represent 38% of the same ratio. In hyena dens, the frequency of carnivores is at least 20% of the total carnivore + ungulate MNI, in contrast to less than 10% in anthropogenic assemblages [8,20].

The spotted hyena, represented only by adults and old individuals, is the most abundant carnivore in Auzières 2 with skull remains (lower and upper isolated teeth) and foot extremities (carpals, tarsals, metapodials, phalanges) the dominant anatomical parts. This anatomical representation is frequently encountered in Pleistocene hyena dens like Plumettes [3], Unikoté [28] in France or Geula Cave in Carmel Mount, Israel [29]. The over-representation of cranial elements is due to the destruction of their bones by their own sort (consumption and trampling) [16]. No hyena coprolites were found. In contrast, ungulate skeletal parts are dominated solely by cranial elements (isolated teeth). The large species, like horses, rhino, and mammoth are represented by many juveniles (milk teeth).

Besides the hyena remains in the site, the bone assemblage contains many digested teeth (ibex, horse, mammoth). Some bones and splinters also exhibit carnivore damage, in the form of gnaw marks or tooth pits. No cut marks made by stone tools were found on any of the bones in this assemblage. A lower molar of a rabbit, still in the corpus of a mandible, shows evidence for digestion of this complete element by a bird of prey.

Thus, these features plead in favor of the spotted hyena as the main collector of the herbivores through the acquisition of prey by hunting or scavenging [8,17,21].

7. Paleoenvironment (Cenogram method)

Large and small mammals are unevenly represented in archaeological levels Cf1 to Cf3 of Auzières 2 cave. Despite the rarity of small mammals, mammalian diversity observed in level Cf2 allowed us to develop a cenogram, which is a graphic representation of the rank-species distribution of non-volant mammal species within an ecologically cohesive fauna [25,31]. A cenogram is plotted by putting on the Y-axis the logarithm of the mean body weight of each species of the community classified in decreasing order of size on the X-axis.

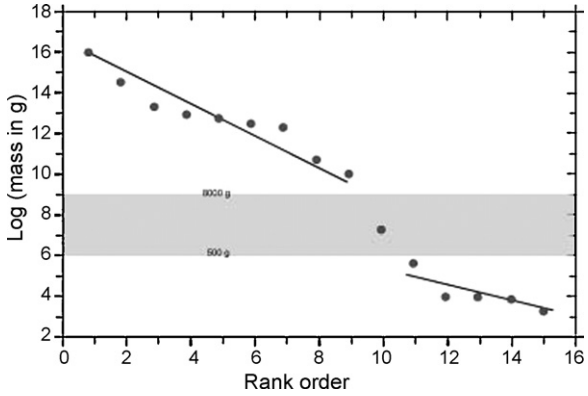

Fig. 4. Cenogram plot of the Auzières 2 (layer cf2) fauna.
Fig. 4. Cénogramme de la faune des Auzières 2 (niveau Cf2).

The Auzières 2 cenogram of Cf2 can be interpreted in terms of environment (Fig. 4): (i) The large mammal is abundant and the slope is slow, which indicates an humid environment; (ii) Medium weight species (between 500 g and 8 kg) are rare, which suggests an open environment. Thus, the cenogram method seems to confirm the hypothesis that the Auzières 2 sequence dates to an Upper Pleistocene temperate phase.

8. Conclusion

There is a strong evidence for interpreting the Auzières 2 cave as a natural site, a hyena den, with little anthropogenic involvement. The spotted hyena is an opportunist predator that usually did not hunt selectively [21]. As such, it may be assumed that the herbivores represented in the assemblage reflect those inhabiting the hunting territory near the den, both in their range and their relative abundance. The presence of remains of a very mature bear within the filling strengthens the idea that Auzières 2 served as a cave den.

The species richness makes the site of Auzières 2 of special interest from a palaeontological, biochronological and paleoenvironmental point of view, for it offers a new and unique perspective on Pleistocene biodiversity in Provence, for the time period posterior to the Bau de l'Aubesier [24] site and contemporary with the oldest layer of La Combette, which the layers E, F and G are dated to 53 ± 4 ka [39,43].

Finally, it is not rare to meet flint tools series in natural sites, like carnivore dens [6,28,29] or avens [6], under-

lining well the complexity to understand the origin and the history of a bone assemblage.

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